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## THE HOUSE FLY AS A CARRIER OF DISEASE

BY EDWARD HATCH, JR.,

Chairman, Fly-Fighting Committee, American Civic Association, New York.

The common house fly has been a follower of mankind since the beginning of history, as doubtless he was for ages before. He is found only where man has made his home; and the newest pioneer settlements soon have a fly population proportionately larger than the older communities. The Egyptian plague of flies is recorded in the Book of Exodus in terms which indicate that the author of the Pentateuch looked upon these insects as something more than mere nuisances; for he says: "The land was corrupted by reason of the swarm of flies" (Ex. viii. 24); and their potentialities for evil were more than hinted at in the name of the Canaanite god Baal-Zebub (Prince of Flies), which in the religious language of a later day became an alternative term for the devil himself.

While the sacred writers seem to have had some appreciation of the pestiferous nature of the fly, references to him in modern literature have been usually of a sportive and flippant character; he has been either the subject of jests or a symbol of weakness and harmlessness. Children have been taught that they must save the interesting little creature when he seems likely to drown in a mug of milk. It is only comparatively recently that he has been revealed in his true colors and shown to have earned the title of "the most dangerous animal on earth."<sup>1</sup>

When the Water Pollution Committee of the New York Merchants' Association was founded a few years ago, one of the first questions for its consideration was the menace to health constituted by the pollution of New York Harbor—a menace whose existence had been denied by certain scientific authorities. The committee therefore made an investigation of the conditions prevailing along the waterfront of Manhattan Island, and proceeded to show the relation between them and the death rate of the districts in the immediate neighborhood of the docks. Dr. Daniel D. Jackson, who conducted the investigation as a member of the com-

<sup>1</sup> Daniel D. Jackson in "The House-Fly at the Bar."

mittee, finding that flies, attracted by the dry and floating sewage in slips and on the wharves, swarmed along the waterfront, set a large number of traps at different points on the North and East river shores. Counting the flies every day, he grouped his results by weeks, thus allowing for both sunny and rainy days. His captives carried innumerable fecal bacilli on their legs and bodies—one fly, taken in South street, having more than 125,000 about him. He found that the increase in the number of such intestinal diseases as typhoid fever and the summer diarrhoea of infants was in direct proportion to the increase in the number and activity of flies. He presented with the report a map of the Borough of Manhattan, with cases of typhoid and intestinal diseases indicated by black dots, by which it was shown that the vast majority of these cases were to be found in the parts of the city nearest the polluted waterfront. A thoroughgoing reform of general sanitary conditions in the districts affected, including the adoption of some system of sewage disposal, would, the report stated, reduce the yearly typhoid deaths in New York very considerably, and the diarrhoeal deaths from 7,000 to 2,000—if germ-infected flies were not permitted to contaminate the milk supply before it reached the city or after. In addition to the lives thus saved, the reforms recommended would reduce the number of cases of illness from these causes about 50,000 annually.

The Jackson report, published by the committee under the title "Pollution of New York Harbor as a Menace to Health by the Dissemination of Intestinal Diseases through the Agency of the Common House-Fly" (December, 1907), was widely circulated, and is perhaps the best known record of experiments tending to establish the responsibility of flies for the spread of disease-producing bacteria. Confirmatory testimony is furnished by many other authorities, as the result of investigations carried on in various parts of the world, so that we need no longer speak of an hypothesis of disease transmission by flies, but may regard the fact of such transmission as scientifically established. I shall in this paper adduce only a small part of the great body of testimony, before proceeding to the discussion of the means which to me as a layman—but a layman who has given much time and attention to the problem—seem most likely to accomplish the extermination of the pest. I may say in passing that, though to the readers of THE

ANNALS it is not necessary to apologize for the plain treatment of the disagreeable phases of the subject, such treatment is sometimes offensive to over-sensitive members of a popular audience, as the committee has more than once found to its sorrow—as when in a city in Indiana the authorities forbade the showing of its moving pictures illustrating the dangers of the fly nuisance, on the ground that they were too disgusting to be presented in public.

A little more than a year ago, Dr. L. O. Howard, Entomologist of the United States Department of Agriculture, proposed the name of “typhoid fly” as a substitute for that of “house fly,” commonly used to designate *Musca domestica*. His suggestion, while it has not actually changed current nomenclature, has been so widely commented upon that it has accomplished much in the way of impressing the popular mind with the fly’s dangerous activities. With true scientific conscientiousness, Dr. Howard explained that, “strictly speaking, the term is open to some objection, as conveying the erroneous idea that the fly is solely responsible for the spread of typhoid; but considering that the creature is dangerous from every point of view, and that it is an important element in the spread of typhoid, it seems advisable to give it a name which is almost wholly justified and which conveys in itself the idea of serious disease.”

There is little danger that any other fly may be made by indignant housewives or health officers to suffer for the sins of *Musca domestica*, for this variety constitutes ninety-eight per cent of the fly population of American houses. A condensed account of its habits<sup>2</sup> will suffice to indicate the ways in which it may carry germs from filth to human food.

Born in manure, generally that of the horse, or in decomposing matter of any kind, vegetable as well as animal, they enter our homes to alight on foods there stored. Their tastes are indelicate and omnivorous; but they subsist on sputum, fecal juices, and the slime and dirt that sticks to exposed surfaces. Their proboscides, through which they feed, are connected with an extremely active salivary gland, capable of pouring out a large quantity of saliva, which the fly projects against a dry surface, swallowing the subsequent solution. Naturally, solid particles, living organisms, parasites, and eggs, small enough, may pass into the digestive tube. Bacilli of different types and eggs of the nematodes have been observed in the

<sup>2</sup> As given by Dr. Gordon K. Dickinson, in the New York “Medical Record,” January 26, 1907.

proboscides, stomach, intestinal tract and dejections. The time that particles remain in the digestive tract of the fly is from twelve to twenty-three days. Evidently the digestive secretions are not active for harm, as organisms will not only pass through alive, but increase in number while in transit. There must be some absorption of the toxins of bacilli, for flies die in large numbers which have had the fortune to imbibe such bacilli as those of the plague and anthrax. Flies are large breeders, lay their eggs by preference in horse manure, but also in decaying meat, meat broth, cut melons, dead animals, and even in cuspidors. On these substances their larvæ subsist until they hatch. From ten days to two weeks after the time the eggs have been laid the fly is fully hatched. It is estimated that one fly, laying 120 eggs at a time, will have a progeny amounting up to the sextillions at the end of the season.

The earliest convincing evidence of the part played by house flies in the dissemination of the typhoid bacillus was furnished by Drs. Vaughan, Veeder, Reed, Sternburg and Shakespeare, who investigated camp conditions during the Spanish-American War. Dr. Vaughan, a member of the U. S. Army Typhoid Commission of 1898, summarized his reasons for believing that flies were active in the dissemination of typhoid fever in these paragraphs:<sup>3</sup>

(a) Flies swarmed over infected fecal matter in the pits and then visited and fed upon the food prepared for the soldiers in the mess-tents. In some instances where lime had recently been sprinkled over the contents of the pits, flies with their feet whitened with lime were seen walking over the food.

(b) Officers whose mess-tents were protected by screens suffered proportionately less from typhoid fever than did those whose tents were not protected.

(c) Typhoid fever gradually disappeared in the fall of 1898 with the approach of cold weather and the consequent disabling of the fly.

It is possible for the fly to carry typhoid bacillus in two ways. In the first place fecal matter containing the typhoid germs may adhere to the fly and be mechanically transported. In the second place, it is possible that the typhoid bacillus may be carried in the digestive organs of the fly and may be deposited with its excrement.

The observations and deductions of American surgeons were corroborated by the British medical officers in the Boer War. "Nothing," says Dr. Dunne, writing in 1902, "was more noticeable than the fall in the admissions from enteric (typhoid) fever coincident with the killing off of the flies on the advent of the cold

<sup>3</sup> "Conclusions Reached After a Study of Typhoid Fever Among American Soldiers." A paper read before the American Medical Association, 1900.

nights of May and June. In July, when I had occasion to visit Bloemfontein, the hospitals there were half empty and had practically become convalescent camps."

That the conditions which prevailed in military camps before the deadly work of the fly was recognized are to be found in many communities in time of peace, and that their agency in spreading disease is equally effective, may be seen—to select only one from numerous instances—from the report of Dr. Alice Hamilton on the typhoid fever epidemic in Chicago in July-September, 1902. Two places in the neighborhood of Hull House were selected as especially favorable for an investigation of the relations between flies and the epidemic.

The first was an unconnected privy on Polk street, into which the discharges from two cases of typhoid fever were being thrown without any attempt at disinfection. The vault was either very shallow or very full, for the dejecta lay within three feet of the opening and had caught on the projecting scantling within a foot of the opening. The flies caught within the vault, on the fence of the yard, and inside the sickroom of one of the patients, which was also used as a kitchen, were dropped into test tubes containing culture medium and allowed to remain there for periods varying from fifteen minutes to twelve hours, and were taken to the laboratory of the Memorial Institute for Infectious Diseases for examination. The full details of this part of the investigation have been published in the "Journal of the American Medical Association." In two of the tubes, the one from the sickroom and the one from the yard, the typhoid bacillus was discovered. In one of the tubes inoculated by flies from the vault a bacillus was discovered closely related to but not identical with the typhoid bacillus, belonging apparently to the group intermediate between the typhoid and colon groups. This is a group of bacilli which have been isolated from patients suffering from typhoid-like affections.

The second place chosen was a yard on Aberdeen street, containing one large, full and filthy vault, not connected with the sewer. This is used by sixteen families. Flies from three privies built over this cesspool were used to inoculate four tubes. Other flies from the fence of the yard and from the walls of the two houses bounding the yard at varying distances from the vault were dropped into six tubes. In three of these tubes the typhoid bacillus was discovered.

Further bacteriological evidence of the transmission by flies of the typhoid bacillus is adduced by Dr. C. Gordon Hewitt,<sup>4</sup>

<sup>4</sup> In "The Structure, Development and Bionomics of the House-Fly, *Musca domestica*, Linn. Part III. The Bionomics, Allies, Parasites, and the Relations of *M. domestica* to Human Disease."

Dominion Entomologist, of Ottawa. He records the recovery by Celli (1888), of the *Bacillus typhi abdominalis*, from the dejections of flies which had been fed upon cultures of the same, and his proof that the bacilli passed through the alimentary tract in a virulent state. Ficken, in 1903, found that "when flies were fed upon typhoid cultures they could contaminate objects upon which they rested. The typhoid bacilli were present in the head and on the wings and legs of the fly five days after feeding, and in the alimentary tract nine days after."

Flies also certainly transmit, according to Dr. Hewitt, and other scientific investigators, the bacilli of tuberculosis, cholera, anthrax, bubonic plague, and possibly those of ophthalmia and one or two more loathsome diseases. But if we confine our consideration to its connection with typhoid fever alone, we must hold the fly responsible for a large proportion of the vast money loss which this country annually suffers from the ravages of that disease. Dr. G. N. Kober, of Washington, has estimated that the decrease in the vital assets of the United States through typhoid fever in a single year is more than \$350,000,000. Physicians are not unanimous as to the proportion of responsibility for typhoid which must be assigned to flies, polluted water and infected milk, but most of them agree in crediting flies with a very important part in its dissemination; and when to this vast sum is added the \$10,000,000 which the people of this country pay annually for screens to protect themselves against flies and mosquitoes, we have what should be a tremendously effective argument in favor of the extermination of the fly pest—even without the infinitely more potent appeal, if it could be made personal, to each of us to guard the health and lives of ourselves and our families.

For the fly plague is not one which must be endured as a visitation of Providence. It may be stamped out by the systematic adoption of one method, and only one, by the individual and the public—the method of cleanliness. The fly is bred in, lives and thrives upon, filth. If you allow no filth to accumulate in your house and your neighborhood, you will not be troubled by flies, for they do not, ordinarily, stray far from their breeding places and their sources of food supply. Even if they should enter a thoroughly clean neighborhood, they could not exist in the face of screens preventing their access to food and in the absence of

manure heaps and other receptacles of filth in which to deposit their eggs. Those who conduct local campaigns against the house fly cannot too strongly emphasize the dictum of the Fly-Fighting Committee of the American Civic Association, "If there is no filth there will be no flies."

One result of the investigations made by Dr. Jackson into the relations existing between flies and sewage was the prosecution, at first within the Water Pollution Committee of the New York Merchants' Association, and later through a special committee of the American Civic Association, of a campaign of education and extermination directed against the fly. A summary of the activities of this committee will furnish suggestions for those who desire to co-operate in the general reform through local organized effort.

The committee, as now constituted, is somewhat larger than in the period of its connection with the Merchants' Association, and most of the members of the Water Pollution Committee, in which it had its beginnings, are members of the new committee (formed in February, 1910). This close association of the two committees is appropriate, for nearly everywhere—in the small towns perhaps more even than in the great cities—untreated and unprotected sewage makes the banks of watercourses the gathering and breeding-places of flies. The membership of the Fly-Fighting Committee is as follows: Edward Hatch, Jr., of New York, chairman; Dr. Daniel D. Jackson, Dr. Woods Hutchinson and Col. John Y. Culyer, of New York; Harlan P. Kelsey, of Salem, Mass.; Mrs. Caroline Bartlett Crane, of Kalamazoo, Mich.; Dr. S. J. Crumbine, State Commissioner of Health, of Topeka, Kan.; Dr. Joseph Y. Porter, State Commissioner of Health, of Jacksonville, Fla.; Dr. Albert VanderVeer, of Albany, N. Y.; Mrs. R. S. Bradley, of Boston, Mass.; Miss Alice Lakey, of the Food Committee of the National Consumers' League, of Cranford, N. J., and Mrs. Gardner Raymond, of Rochester, N. Y.

Each member of the committee is a center for his or her part of the country—and the members are pretty widely distributed, geographically—for the dissemination of educational literature bearing upon the subject of flies, and so well has the work been done that very few people who read the newspapers can plead ignorance of fly dangers as an excuse for not excluding the pest from their neighborhoods and their houses. The committee sends free to phy-



sicians, health officers, teachers, social workers—in fact to any one who expresses an interest in the subject—such literature, prepared under its direction, as “The House-Fly at the Bar” (a compilation of scientific opinions, popularly expressed, as to the fly’s guilt in the matter of disease dissemination); “Rules for Dealing with the Fly Nuisance” (for posting in hotels, schools, factories, stores, etc.), and “Beware of the Dangerous House-Fly” (a simply-worded tract for popular distribution, particularly among school children). One of the most effective and popular means of bringing home to the average person what it means to allow the fly to flourish and have free access to houses and food is the moving picture film, entitled “The Fly Pest,”<sup>5</sup> made in Europe under the auspices of a representative of the committee, which has been shown in hundreds of moving picture halls and is still a “drawing card.” The series of pictures shows flies (as big as Plymouth Rock hens, as they appear on the screen) laying eggs in filth; the eggs in white masses; the maggots in writhing heaps as they emerge from the eggs, and in different stages of their growth as maggots, until they burrow in the dirt to enter the pupa state; the pupæ (or grubs) themselves, one day later; flies emerging from the filth, at first wingless; then the perfect adult fly. Then follow pictures stretching across the screen, of a fly taking a sip of honey from the point of a needle, showing the action of the proboscis, very like an elephant’s trunk in miniature; of the tongue, and of the foot, also enormously enlarged, and with every microscopic hair distinct.

The second act of this little life history is entitled “How Flies Carry Contagion.” In it these scenes follow one another in rapid succession, so that the most thoughtless spectator cannot fail to grasp their full significance: flies swarming over putrid fish; crawling over lumps of sugar; in a cuspidor; on the nipple of a baby’s feeding bottle, and, last of all, a pretty baby placidly sucking the mouthpiece from which the flies have just departed.

The usefulness of this method of propaganda is shown by the action of Dr. W. A. Evans, health officer of Chicago, who has been giving free lectures on the fly pest in the moving-picture theatres in that city. All over the country there has been gratifying co-operation in this educational work between enlightened moving-

<sup>5</sup> Controlled by the Kleine Optical Company, Chicago, Ill.

picture showmen and the various agencies working for fly extermination.

Lantern slides illustrating the same subject as the film, to be used in lectures for which moving pictures are not available, are loaned to responsible persons who make application to the committee. A traveling exhibit, consisting of photographs illustrating and placards warning against the fly pest, is also to be had by local organizations which guarantee to pay express charges and to return it intact. The pictures and placards are mounted on a folding screen, about six feet high, and the whole exhibit may be packed snugly in a substantial wooden box which accompanies it.

The committee plans this year (1911) to extend its educational campaign among the school children, and to this end has instituted a system of prize competitions in essay writing on the subject, "The House Fly as a Carrier of Disease." The pupils of the public and parochial schools taking part in these competitions will be supplied with the material for their essays, contained largely in the "literature" to which reference has already been made.

Another line of work has been projected, namely, the preparation of a "white list" of hotels and summer resorts that take proper precautions against the fly pest; information being solicited from all members of the American Civic Association.

Now for a few practical suggestions as to the means of exterminating the pest. Dr. Howard says:

Even if the typhoid or house fly were a creature difficult to destroy, the general failure on the part of communities to make any efforts whatever to reduce its numbers could properly be termed criminal neglect; but since it is comparatively an easy matter to do away with the plague of flies, this neglect becomes an evidence of ignorance or of a carelessness in regard to disease-producing filth which to the informed mind constitutes a serious blot on civilized methods of life.

The methods of ridding a neighborhood of flies are, as Dr. Howard has intimated, comparatively simple, or would be so, at any rate, to a fly-fighter with despotic power over a community. For to insure the success of this work co-operation is absolutely essential. One carelessly conducted stable may nullify the conscientious efforts of a whole neighborhood of fly-fighters, although they always have the resource of bringing moral suasion to bear upon the proprietor of that stable. But while the creation of a

proper community spirit is necessary—a spirit which shall bring home to each householder his responsibility for maintaining sanitary conditions on his premises—the benevolent despotism of the health officer is the most effective single agency for carrying out the reforms for which this committee is striving. Fortunately, the great majority of health officers are so thoroughly alive to the dangers of the fly pest that they are at least willing to enforce any fly ordinances which public opinion is strong enough to have enacted, even if they are not, as they generally are, pioneers in the anti-fly movement.

Such pioneers are the members of the Indiana State Board of Health, who have framed and sent to the mayors of all the cities in the state the following ordinance:

WHEREAS, It is commonly known that flies are very dangerous carriers of filth, filth poisons, and disease germs, that they are born in filth, and are a constant threat against the health, happiness and prosperity of the people; therefore,

SECTION 1. Be it ordained by the Mayor and Council of the city of ———, that it shall be unlawful for any person, firm or corporation to suffer or permit or have upon their premises, whether owned or leased by them, any one or more of the following unsanitary fly-producing, disease-causing conditions, to wit: (1) Animal manure in any quantity which is not securely protected from flies; (2) privies, vaults, cesspools, pits or like places, which are not securely protected from flies; (3) garbage in any quantity which is not securely protected from flies; (4) trash, litter, rags or anything whatsoever in which flies may breed or multiply.

SECTION 2. It shall be the duty of the chief of police or city marshal and health officers, upon learning in any way whatsoever of the existence of one or more of the unlawful conditions described in Section 1 of this ordinance, to notify the offender in writing, upon order blanks provided by the city clerk, to remove or abate said unlawful conditions, stating the shortest reasonable time for such removal or abatement. In the event of the refusal or neglect on the part of the notified offender to obey such order, the chief of police or health officer shall inform the street commissioner, upon a blank provided by the city clerk, and it shall then be the duty of said street commissioner, and he shall have power and authority, to remove and abate the reported unlawful conditions; and he shall keep an accurate account of the cost and expenses thereof, which shall be paid from the city treasury upon the sworn vouchers of the street commissioner, and said cost and expenses shall be a lien upon the property and shall be collected by law as taxes are collected and duly paid into the city treasury.

SECTION 3. Any person, firm, or corporation found guilty of having created or suffered to exist on premises either owned or leased by them

any one or more of the unlawful conditions named in Section 1 of this ordinance shall be punished by a fine of not less than five or more than fifty dollars.

SECTION 4. All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed; and whereas an emergency exists, this ordinance shall be in effect upon and immediately after its passage.

This draft of a proposed ordinance, which I consider admirable as directing attention to filth as the sole cause for the existence of flies, has been copied by the Kansas and California boards of health and extensively circulated in those states. I hope the time may soon come when we shall see every city with such an ordinance rightly enforced.

The "Rules for Dealing with the Fly Nuisance," circulated by this committee, are as follows:

Keep the flies away from the sick, especially those ill with contagious disease. Kill every fly that strays into the sickroom. His body is covered with disease germs.

Do not allow decaying material of any sort to accumulate on or near your premises.

All refuse which tends in any way to fermentation, such as bedding straw, paper waste, and vegetable matter should be disposed of or covered with lime or kerosene oil.

Screen all food whether in the house or exposed for sale.

Keep all receptacles for garbage carefully covered and the cans cleaned or sprinkled with oil or lime.

Keep all stable manure in vault or pit, screened or sprinkled with lime, oil or other cheap preparations, such as are sold by a number of reliable manufacturers.

See that your sewage system is in good order; that it does not leak, is up to date, and not exposed to flies.

Pour kerosene into the drains.

Burn or bury all table refuse.

Screen all windows and doors, especially in the kitchen and dining-room.

If you see flies you may be sure their breeding place is in nearby filth. It may be behind the door, under the table or in the cuspidor.

If there is no filth there will be no flies.

If there is a nuisance in the neighborhood write at once to the health department.

#### TO KILL FLIES

The London "Lancet," the leading medical journal of the world, says that the best and simplest fly-killer is a weak solution of formaldehyde in water (two teaspoonfuls to the pint). Place in plates or saucers throughout

the house. Ten cents' worth of formaldehyde will last an ordinary family all summer. It has no offensive smell, is fatal to disease organisms, and is practically non-poisonous except to insects.

Pyrethrum powder, which may be bought at any drug store, burned in the house, will also kill flies.

These rules go further than the Indiana ordinance in including directions for screening houses and food, and I believe cover all practical points. At any rate, with these and the ordinance enforced in any community I should be willing to take all the chances of disease transmitted by flies that might be afforded me.

No enthusiast in the movement for the extermination of the fly should delude himself with the belief that the end he seeks is to be attained with ease. To be sure, the replacing of the horse by the automobile makes the city streets less inviting to flies; and as they are not given to flying more than eight feet high, our sky-scrapers are in great part free from them; nevertheless, we cannot hope that the mere advance of invention will rid us of the plague. It is easy and simple to say, "If there is no filth there will be no flies;" and it is a comparatively simple thing so to order one's own house that flies shall have no breeding place in and immediately about it; but to insure the same care on the part of one's neighbors and the general public is the difficulty. Hence the necessity for organization to educate the public to a realization of fly dangers and to build up a body of public opinion which will make possible the enactment and enforcement of such measures as I have recommended. In such educational movements the newspapers and the press generally will be found able and willing co-workers; I recommend all fly-fighters to secure their powerful support at the outset of the campaign. And to any readers in whom this paper may have aroused an interest in this very important subject I promise, on behalf of the Fly-Fighting Committee of the American Civic Association, all the additional information and assistance at its command.